Post-mortem changes in measurements of grebes

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The study of geographical variation in birds is mainly based on skins in museums, a domain of specialists. Others measure live birds, notably at ringing stations, for example to determine the provenance of migrant birds. Mensural differences between populations may be very small, so sources of error have to be minimized, and this has led to critical discussion of the way in which to take measurements. (Compare the classical standards, Baldwin *et al.* (1931) and Witherby *et al.* (1938–41) with recent contributions like Kehm (1970) and Svensson (1972).) However, it is rarely that consideration is given to whether measurements of live birds are comparable with racially diagnostic measurements based on skins.

It is documented that wing-length varies with the humidity of the feathers (Evans 1964) and with changes soon after death (Bröchel 1973). Since there is connective tissue in joints and around feather follicles, the wing-length shrinks after skinning (see e.g. Svensson 1975). Vepsäläinen (1968), for instance, found a 2% shrinkage in the wings of 11 *Vanellus vanellus*. Yet, very few students of geographical variation have made corrections for this shrinkage, and post mortem changes in other measurements have received very little attention (see Greenwood 1979 for review).

During a study of geographical variation of *Podiceps auritus* (Fjeldså 1973), and of character displacement in Andean grebes (Fjeldså 1980, ms), I found that all the usual measurements changed with time. To permit pooling of measurements of museum skins with specimens found dead but not worth preserving, all dimensions from skins needed correction for shrinkage. The results of a detailed study of post mortem changes in the weeks after death are presented here.

Materials and methods

15 *Podiceps auritus arcticus,* collected in Norway 1971 and in Iceland 1969, were measured fresh and again after 4–9 weeks; 6 Danish oil casualties of *P. grisegena grisegena* were measured dead (several weeks old, frozen most of the time) and at 1, 4, 9, and 18 weeks after skinning; grebes collected Oct 1977 – Jan 1978 in Peru, comprising 7 *Rollandia (Centropelma) microptera,* 12 R. *rolland chilensis* and 16 R. *rolland morrisoni,* 6 *P. occipitalis juninensis* from Junín and 9 others of a longer-billed population from Puno, and 7 *P. taczanowskii,* were measured fresh, again in mid Oct 1978 and at end of Mar 1979.

All the birds were measured by the author as follows: the wings were flattened on a ruler without straightening the primaries or digital joints (following Svensson 1972); the tarsus and straightened middle toe with claw were measured with sliding calipers (following Baldwin *et al.* 1931); the outer and inner toes of *P. auritus* were measured; the exposed culmen (chord) was measured with sliding calipers; depth and width of the closed bill on a level with the mid-dorsal feather edge were taken with sliding calipers.

Tables 1 and 2 show the average post mortem changes, expressed as the factor by which "dry" measurements must be multiplied in order to obtain the "fresh" measurement. Table 1 shows variation in correction factors according to time after skinning, Table 2 differences between species.

Table 1

Correction factors for post mortem changes in measurements of skinned grebes (Podicipedidae), relative to time after skinning. Values are the factor by which the measurement of a skinned specimen should be multiplied to get the fresh measurement.

	Time after skinning, weeks							
	1	4	9	18	39	42–51	59–63	67–72
	Podiceps griseigena	*Podiceps auritus and P. grisegena*	*P. aur: P. gris:*	*P. gris:*	*Rollandia rolland Rollandia microptera Podiceps occipitalis Podiceps taczanowskii*	*R. roll: R. micr: P. occ: P. tcz:*	*R. roll: R. micr: P. occ: P. tcz:*	*R roll: R. micr: P. occ: P. tcz:*
n =	6	17	10	6	16	37	23	30
	Correction factors							
wing		1.008	1.020	?	1.029	1.030	1.028	1.029
tarsus		1.004	1.006	?	0.004	1.005	1.003	1.005
toe middle		1.028	1.005	?	1.034	1.026	1.033	1.027
culmen exposed	1.007	1.014	1.011	1.011	1.037	1.039	1.038	1.039
bill depth	1.042	1.042	1.052	1.054	1.108	1.087	1.105	1.084
bill breadth	1.066	1 035	1.051	1.075	1.163	1.129	1.160	1 131

Table 2

Correction factors for post mortem changes in grebes (Podicipedidae). The first figure in each column is the mean dimension (mm, fresh specimens), followed by the correction factor by which the measurement taken on a skin must be multiplied to get the fresh measurement. The value is the mean for the measurements taken Oct 1978 and Mar 1979. Below these two figures is given the coefficient of variability (CV), 100 S.D./M, for the correction factor.

n		Wing	Tarsus	Middle toe	Culmen	Bill depth	Bill breadth
7	*Rolandia microptera*	118.7; 1.041 CV1.1%	48.6; 1.016 CV2.6%	68.6; 1.033 CV1.4%	34.9; 1.038 CV3.0%	13.8; 1.145 CV8.3%	11.5; 1.214 CV11.7%
12	*R. rolland chilensis*	111.0; 1.018 CV1.7%	35.9; 1.006 CV1.8%	49.2; 1.022 CV1.3%	19.3; 1.025 CV2.3%	9.0; 1.030 CV3.9%	7.0; 1.029 CV6.2%
16	*R. rolland morrisoni*	114.5; 1.019 CV3.6%	36.6; 1.001 CV1.2%	52.8; 1.027 CV1.9%	23.2; 1.040 CV2.2%	10.4; 1.079 CV5.8%	8.1; 1.159 CV9.4%
9	*Podiceps occipitalis* from Puno district	138.6; 1.035 CV3.6%	38.7; 0.988 CV3.5%	52.4; 1.031 CV1.6%	20.3; 1.048 CV2.2%	7.8; 1.079 CV4.1%	7.9; 1.130 CV6.1%
6	*P. occipitalis juninensis* from Junín	130.1; 1.037 CV2.4%	37.6; 1.011 CV 1.1%	49.9; 1.038 CV1.4%	17.1; 1.004 CV 0.3%	7.6; 1.100 CV8.2%	7.6; 1.248 CV7.0%
7	*P. taczanowskii*	125.0; 1.037 CV1.5%	42.6; 1.018 CV 0.8%	56.7; 1.033 CV1.8%	30.5; 1.035 CV 1.6%	9.6; 1.134 CV3.0%	9.0; 1.156 CV6.4%

Rate of post mortem shrinkage

Six *grisegena* which were kept very dry changed quickly but only slightly. However, the figures may be misleading since the birds were not fresh when first measured (see above). All the other birds used were made into skins within a few hours after death, but since they were dried in the field, some in a tent during periods of much rain, the results may not apply to skins made in taxidermists' workshops with good conditions for drying. The birds from Peru were exposed to very moist conditions during shipment to Copenhagen, arrived quite soft, but were efficiently dried prior to the October measurement.

Specimens measured after 1–18 weeks give generally lower correction factors than the Peruvian birds, possibly because the former were not yet dry. On the other hand, no shrinkage could be detected from the 39th to the 72nd week. Unfortunately it is not possible from the data obtained to tell for certain at what interval after skinning the shrinkage stopped.

Comparison of fresh and dry specimens

Wing-length

The average correction factor for birds used in Table 2 is 1.029. It is very similar in 2 populations of *occipitalis* and the closely allied *taczanowskii* (1.035, 1.037, 1.037). Although *taczanowskii* is flightless, this is mainly due to reduction of the sternum, and the anatomy of the wing is scarcely different from that of *occipitalis* (cf. Sanders 1967). Shrinkage was similar in 2 races of *rolland* (1.018, 1.019), but the correction factor was higher (1.041) in their near relative *micropteram,* which is flightless and with reduced wings (Sanders 1967). The differences may be due to the differences in anatomy, although present knowledge of the anatomy offers no obvious explanations.

Tarsus

The shrinkage is variable and mostly insignificant. 29% of the birds gave a slight post mortem *increase,* which suggests that it is difficult to take the measurement precisely.

Middle toe

The average correction factor is 1.030, with some variations between species. Some extreme values (0.996–1.075) may be due to inaccuracies arising if the toes of skinned birds are much bent. The few *auritus* measurements suggest that the shrinkage of the 4-jointed outer toe is still larger, while that of the 2-jointed inner toe is smaller.

Bill

The average correction factor for the culmen is 1.038. The factor is small in specimens with a bill of less than 20 mm (e.g. all *occipitalis* from Junín). This suggests that particularly short-billed grebes have a thin rhamphotheka, so that the bill is filled with bone in almost its entire length.

Depth and width of bill, at base, are subject to great changes. The average correction factors are 1.093 (max. 1.322) and 1.145 (max. 1.488), respectively. Three specimens showed post mortem *increases* in one or the other dimension. The main depth factor appears correlated with the average bill length for the population. A close examination showed that correction factors for well made skins were in fact 1.00–1.11 and 1.00–1.14, respectively. The mean values

are much influenced by some poor specimens in which either the bone at the bill base or the palate had been damaged by shot or in which the palate bones had been cut away in order to get rapidly through with the skinning. In such cases the basal parts of the bill may completely change shape as the drying connective tissue between the nasal rami pull them together, the bill then also easily becoming deformed by external forces.

Conclusions and recommendations

The investigation suggests greater post mortem changes than previously expected; wings as well as toes decrease by about 3%. The tarsus measurement, which does not span joints, changes very little. The marked change in bill dimensions, with a fully 4% decrease in length (except in very fine-billed examples), and considerable reduction in thickness of some (damaged) bills, may not be applicable to other birds, the amount of change probably depending on the bill anatomy. In the case of a tough bill like that of a finch, changes may be slight. Grebes are holorhinous and schizognathous, like gallinaceous and many gruiform birds, with the basal half of the bill consisting of slender, pliable bony bars. A schizorhinal (deeply split nasal bone), pliable bill, as in waders, probably allows even greater post mortem changes. Here even hypertrophy and softening of the distal part of the rhamphotheka may permit considerable post mortem shortening of the bill. Certainly separate correction factors should be calculated for different anatomical bill types.

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References:

Baldwin, S. P., Oberholster, H. C. & Warley, L. G. 1931. *Measurements of Birds.* Sci. Publ. Cleveland Mus. Nat. Hist.: Cleveland.

Bröchel, K. von 1973. Vergleichende Messungen an lebenden und frischtoten Gartengrasmücken (*Sylvia borin*). *J. Orn.* 114: 118–122.

Evans, P. R. 1964. Wader measurements and wader migration. *Bird Study* 11: 23–38.

Fjeldså, J. 1973. Distribution and geographical variation of the Horned Grebe *Podiceps auritus* (Linnaeus, 1758). *Orn. Scand.* 4: 55–86.

— 1980 The endemic grebe *Podiceps taczanowskii* of Junín, Peru. (*Wildfowl.* In press).

— Ms. Comparative ecology of Peruvian grebes. A study in mechanisms for evolution of ecological isolation. Ms. c. 160 pp.

Greenwood, J. G. 1979. Post-mortem shrinkage of Dunlin *Calidris alpina* skins. *Bull. Brit. Orn. Cl.* 99: 143–145.

Kehm, H. von 1970. Beitrag zur Methodik des Flügelmessens. *J. Orn.* 111: 482–494.

Sanders, S. W. H. 1967. The osteology and myology of the pectoral appendage of grebes. Thesis. University of Michigan, Ann Arbor.

Svensson, L. 1972. Welches Flügelmass ist richtig? *J. Orn.* 113: 111–112.

— 1975. *Identification Guide to European Passerines.* 2nd ed. Naturhistoriska Riksmuseet, Stockholm.

Vepsäläinen, K. 1968. Winglength of Lapwing (*Vanellus vanellus*) before and after skinning, with remarks on measuring methods. *Orn. Fenn.* 45: 124–126.

Witherby, H. F., Jourdain, F. C. R., Ticehurst, N. F. & Tucker, B. W. 1938–41. *The Handbook of British Birds.* Witherby: London.

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